NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
By
Honorable James E. Webb

(4 May 1967)

GENERAL TACON: (Introduced the speaker).

MR. WEBB: Thank you very much, gentlemen.

Sitting in this chair I feel a little bit like I am back in the Mercury days, all alone in a great big wide-open atmosphere that is not exactly conducive to equanimity; and I guess all our four astronauts felt that way in Mercury, because we had troubles with every flight -- which illustrates again, I think, how difficult it is for man to move out into a wholly new and hostile environment by the use of new technology.

It is interesting, I think, that Surveyor is digging trenches on the Moon. It is also interesting that it is the second generation spacecraft and that there is a third generation spacecraft out around the Moon, Lunar Orbiter.

It is a rather remarkable thing that Lunar Orbiter was built by a company that was the highest bidder, not the lowest bidder, and that all three of them are working. So you might ponder that in terms of going back to 1916, when the National Advisory Committee for Aeronautics was established to get research done in aviation. And then ten years later we had to modify the procurement laws through the Air Commerce Act of 1926 in order to establish a means to get design competition and to set up the rule that in aeronautical

matters we would buy the best equipment and not the cheapest equipment.

I think the present operation in the Space Agency has more kinship to that process of intellectual activity with science done on campuses, with the muscle of American industry brought in at a proper time, but with devices like wind tunnels available in government laboratories, indeed a combination of government, industry, and science through an organization that was paid for by the Government but was called the National Advisory Committee on Aeronautics. It is a little bit like I said to some of you a few years ago, that the Bureau of the Budget has survived because its name concealed its function. In some ways NACA and NASA have a kinship to the Bureau of the Budget. That is not the only connection.

Now let me pursue this matter of third generation spacecraft just a bit further. The Apollo is the third generation manned spacecraft. We have flown it successfully three times.

On the first test of the guided system we flew equipment that was directly related to the NACA type of philosophy. This equipment was produced in its first working models at the instrumentation laboratory at M.I.T. by Dr. Stark Draper and his group. These men had done guidance systems for Polaris and, I think, Titan, and had developed a very real capability. Indeed, I believe it was Dr. Draper who, when the question of a mobile deterrent force came some ten or twelve years ago, asked the question, when someone talked about putting these missiles on railroad cars, trucks, and ships:

Why don't you put some on a submarine? Then the question was immediately asked: Can you locate the submarine so that you can fire? If you have to surface can you locate it rapidly enough? And he said: Why do you surface? Then he was asked: Well, can you locate it under the water? He said: Yes. And he gave his own estimate of the degree of accuracy which could be achieved with the then known state of the art; and, indeed, today the accuracy is about four times what he predicted, and four times the basis of the decision.

Well, from this experience, when we asked him if he would do the Apollo guidance system, he said he would. We asked him how long it would take, and he said: "It will be ready when you need it." So we gave him the contract.

We were going on what he had done on the other systems for the military Services. But two things happened that I think are important for you to think about.

First, 200 engineering Ph.Ds. were trained by working with this equipment in the instrumentation laboratory while it was being developed and the first models tested. This means that a man getting his Ph.D. knew that the gyro he was designing, working on, constructing, and testing either would carry men to the Moon or would not carry them there. There was not any way that he could escape the fact that his work was going to be tested in actual flight on a difficult mission.

The second thing that I think is important is that the basic work theretofore done was reduced to general principles so

that there is now available as a result of that work a body of knowledge that can be applied in ways that were not available to this country before.

Incidentally, industry was given $203 million worth of contracts to produce the equipment, to produce the muscle once that work had been done. When I was asked by the President to go and talk in Germany, and stopped in England on the way to discuss whether or not we could depart from the previous practice of cooperation through having each nation agree to do its particular chores, like develop a satellite or the scientific instruments to go on a satellite, we would agree to launch it, track it, and provide the information back to the scientists of that country so they could publish, when we were discussing the possibility of going beyond that to a joint effort with Germany so that Germany could then become a better partner in an international framework of cooperation, because it was not competitive with France, for instance, at that time, we (Draper went along with me to see how this political framework of negotiation with other nations takes place -- he was a little surprised at that as I was at the state of technology in his laboratory) stopped and he made the statement in both those nations that it was possible through the application of then known knowledge, plus the new developments in re-entry physics, to improve the accuracy of the present Polaris system by a factor that would approximate one million.

Now, these are fairly startling figures when you think that this has happened in six years in that laboratory.

Well, I use that only to illustrate a process and to come to a point that you can ask questions in a few moments, and to stress the fact that in the guidance system on the third generation of manned spacecraft produced in less than ten years in this nation -- the first flight went 18,000 miles without being updated from the ground, positioned itself correctly, and re-entered the earth's atmosphere, heated up, slowed up, positioned itself again and skipped out of the atmosphere into space and went another thousand miles and re-entered the second time, and on the second re-entry the guidance system, produced in the manner I have described, was calling for a correction of 194.7 miles; and the actual error, when the parachute opened above the airplane that was there waiting for it, was 203 miles. So you had an eight-mile deviation from what the brain was calling for. The error was really caused by a failure to completely understand the lift-over drag ratio of the capsule itself, plus the atmospheric situation that related to the calculations necessary for correct re-entry physics.

Now, gentlemen, if you can skip straight ahead, you can skip sideways. This is a remarkable thing. This is a stabilized inertial platform made to conform to general principles and with an extreme application of accuracy in the pick-offs and in the utilization of the information from the pick-offs. Remember, this is not dated and this same application today, I believe, would make it possible to take off two airplanes from California and bring them into New York without updating that position from the

ground at all and within maybe a minute-and-a-half apart; and also to position airplanes accurately going across the Atlantic Ocean within a very few miles, and might well be a major departure from the present system of controlling aircraft around the world.

I do not want to linger too much over this very high degree of accuracy based on an understanding of the basic principles and the application through engineering.

Quickly, if you think of Apollo as a third generation manned spacecraft, Lunar Orbiter as the third generation Lunar spacecraft, Pioneer ~~A~~ and as the first, Mariner ~~II~~ the second, and Voyager ~~III~~ the third generation of the interplanetary spacecraft, you recognize that we have moved a very long ways in a short period of time. The President is projecting to the Congress and asking for approval a production rate of eight Saturn vehicles a year after 1970 -- four of the big ones and four of the small ones.-- and their utilization not for further scientific exploration, not only to extend the stay-time of man in space for up to a year, but also to land an automated biological laboratory on Mars in 1973 and determine whether life exists there.

So fast is this utilization of the rocket technology to conquer new environment proceeding, already scientists are discussing a general theory of planetary atmosphere to give them increased theoretical foundations for their understanding of the earth's atmosphere through comparing it with the atmospheres of Venus and Mars, already we are applying the feedback principle that makes this possible in hospitals, experimentally, in reducing the mortality

rate by fifty percent in the first three days of cardiac patients coming in where they could be properly instrumented immediately, so that every bit of therapy that is applied is immediately effective in the body and in the instruments measuring what is happening in the body and, therefore, the doctor can determine immediately whether the therapy is right or not, just like you have to determine immediately on launch whether or not that rocket needs a correction in order to go forward with its flight.

This real time decision-making through an immediate feedback of information is the basic ingredient of the management system that has brought 20,000 companies, 420,000 men and women in industrial factories, some 10,000 scientists, engineers, and graduate students on the campuses of 150 universities into a system that uses 90 to 95 percent of the resources outside the Government.

It is a very difficult thing to have the tenuous connection of a contract with the actual muscle power, man power, brain power that does this work. NASA did commit itself to endeavor to make that form of management work; it is making it work, no matter what you may read in the newspapers every day about one inspection report. Just bear in mind that in the Gemini program twenty men went into space in twenty months and that we have developed a capability to generate three generations of spacecraft in every major field in this short period of time.

Right now employment in the industry has dropped from 420,000 to about 350,000; about 5,000 people per month are being

extruded from the factories working in the NASA program. I think we have accomplished that without a great perturbation. It is in a way, I think, rather remarkable that we have been able to work with industry to do advanced research and development where there was to be no large follow-on production on which profits could be made.

Each industry had to go through a double-learning process. They had to learn the complexities of hardware, where in the third generation of manned spacecraft, Apollo, you moved up to a million-and-a-half pieces in the command and service module. This compares with something between 25,000 and 50,000 in Mercury, 236,000 in Gemini, a million-and-a-half in the Apollo.

The companies have had to learn to do this kind of work and make a profit on it. That making of a profit and satisfying the schedule requirement require a second learning period. Once they have learned how to do the hardware, do the testing that gives reliability in it, they then have to learn a management system by which they can keep visibility, satisfy the Government with respect to the efficiency of the operation and ability to deliver on time; they also have to satisfy their stockholders that they can make a profit in that process. And they have to compare the profit they make there with other available profits in our very affluent society where every industry that has real ability is in demand.

Well, maybe I should stop there.

I do want to say that the agency that built up this capability

has worked in the closest and most intimate relationship with our military Services, with other agencies like the Federal Aviation Authority, is now working increasingly closely with the Department of the Interior and the Department of Agriculture in developing the capability of satellites for resource surveys and for studies of phenomena on the earth that are important to those departments; it has worked very closely with the Weather Bureau, so that in our third generation of weather satellites we now have a capability to take a picture every thirty minutes of a third of the earth out over the Pacific, send this information back to the Weather Bureau, have it processed in practically real time, send it right back to the satellite, which then relays it down to that same one-third of the earth. We do this every day.

It is a rather remarkable third generation spacecraft in the weather field built on this close relationship between NASA and the Weather Bureau and those elements of the military system that are involved in weather.

COMSAT Corporation, you know about that. We launch their satellites. We are in the third generation of communications satellites.

So maybe, having made this point, I should stop now and answer questions, if you want to ask them.

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4 May 1967

Discussion

DR. HOUSTON: Gentlemen, Mr. Webb has thought it might be of more interest to all to reserve the major share of his time this morning for your questions. He is ready to entertain your questions. Who wants to begin?

QUESTION: Mr. Webb, probably the one item receiving the most publicity today is that of defects in the Apollo capsule. Will you comment on the recently released so-called Phillips Report? Will you comment on the confidential General Electric Report that was published yesterday in the New York Times?

MR. WEBB: You boys really keep current, don't you? First of all, in the first learning process that I described--how to do the hardware--we had to make an investment of approximately $7 billion in the development of the equipment itself, in the testing and testing and testing to get reliability, the movement of the equipment onto integration with the total system, and then the checkout and launch of this equipment--about $8 billion in the

big booster; so you are talking about $15 billion in these two items.

The companies that went to work in this program work on the basis of about 50 percent done by the prime contractor and maybe 55 percent subcontracted out. The major units are subcontracted out.

You have a very difficult weight problem; you have plumbing in a closed capsule in the Apollo, whereas on Mercury we could put the plumbing on the outside. We did not have to have a heat shield except on the blunt end for re-entry because the re-entry speed from earth orbit is much lower than from the escape velocity required to go to the moon. You also had a requirement for extreme reliability.

We went through major tests up through the ninth Apollo spacecraft and had many, many different changes to undertake. The process is a bit like a pyramid, where you start at the bottom; you do a lot of work; you move up to the next stage; each stage requires increased rigidity and thoroughness of testing, with extrusion of the problems, the solution of the problems, the feedback in to the next agent. At the end you are supposed to get to the point you can launch. But it is a process of learning

together, with the Government and industry in a system that no one has ever made work before and where the energy dissipation on return is at least four times that from orbital speeds and where you have to launch six million pounds from the earth, proceed up above the air, get into orbit, launch from orbit, coast two days, and then let the gravity of the moon draw you in, go into orbit, then drop down a little spacecraft from orbit on the moon.

Every company that has undertaken to do this kind of work has encountered, roughly, the same kind of problems. I think we have used one of the greatest and ablest men alive in the world today, General Sam Phillips, as the manager of this program. He is the manager of the Minute Man program. I think that without a doubt he is the most capable man this country has or I have ever known.

In the process of teaching companies how to do this work we do not have the benefit of the classification system of the military or of the Atomic Energy Commission. If a crane drops a piece or a crane operator bumps a stage against the side of a building and something gets dented, it is in the newspapers the next day. The plain fact is, this is a new system of working.

We had trouble on every Mercury flight, and we had great troubles developing the capability to go with Mercury.

The Gemini was, in effect, a Block II Mercury which incorporated all of the things we had learned in Mercury, gave us longer stay time, but with an open-ended capability so that we could take the equipment, work with it in orbit, and gradually utilize it as far as we could to learn what we needed to know. I would like to point out to you that there was a basic miscalculation there. It was that one astronaut could sleep while one was working and that you could get 24 hours' work a day from one astronaut. It turned out they could not; they interfered with each other; they had to sleep at the same time; weightlessness was more debilitating than was thought, working in a spacecraft. So we had to immediately go out and buy $80 million worth of computer equipment in our Mission Control Center at Houston and go right into a major reorientation to do on the ground what we could not get done by astronauts in the air. I just point out: Here was a learning process.

In the case of the Apollo--and I should say that the management reports in every factory where we work this kind of thing are just about as brutal as anything you have read in the

newspaper about North American--and we are not through with it yet because the company is working on the advanced equipment that you read about in the newspaper. We have General Phillips' comments as to how they compare in what they are doing with what they should be doing to make the mission succeed. I have called six major companies within the last week to ask what they can do and what they have to offer; every one of them that has worked on the Minute Man program, including the biggest and best in this country, told me it made their hair curl to go back in their files and see what General Phillips had said about them in the process of developing Minute Man.

This is not something that is just a bit of skullduggery or incompetence; it is a basic problem to get American industry to do this. Second is the problem to do it where you have really no ability to protect this information. The basic situation is that General Electric, in this report published yesterday, has been given a contract, not only to do the automated checkout system that gives you the same computer storage and retrieval of information on the first tests of engines and equipment right through the launch, but also to examine the flight equipment and record the defects. Remember, we do not have the people to do this.

We do all of this with contractors. They were chosen for this purpose. They furnished about 30 copies of this report. Somebody handed one to a newspaperman. It is completely unclassified. The newspapers decided it important enough for the front page.

While it does not give an account of the Apollo program, it is controversial and spectacular because of the fire. Had there been no fire, the editor would probably have put it on the back page. So you have this up-and-down situation due to what the editor thinks is interesting. The writer for the paper now knows that unless he gives the editor something that is either controversial or spectacular, he does not get his name on the front page behind the story. So, you have this combination of pressures and problems and learning processes.

I would like to say that over the next year or two if we cannot absorb this capability to do things this way, we are not going to have a space program, or it is going to have to be turned back to the military, or classified--one or the other. This is a tremendous problem that the country has now. Can you, in fact, do this kind of business?

If any one of you were told--if you had never seen a butterfly before--to take a caterpillar and make it into a

butterfly, I guarantee you would make some mistakes in your approach to the problem! If every mistake were published in the paper, you would not look so good to your wife and children when you went home at night!

It is not easy to make these advanced systems. There has been a lot of talk about soldered joints. This is not going to be published in the next few days, I hope, whatever I have to say, or talked about outside of here, but we are going right back up to Congress and say that those soldered joints are the way to run the Apollo, and we want to keep them in there. We are going to change 17 joints to braised joints, where there is heat. We are going back there and say that one gas system is the best system we know how to develop, and we are going to use it on these Apollo missions until somebody stops us. We are going to put in an alternate capability to have air in the capsule, with oxygen in the suit, and bleed down the capsule in space to get rid of the air, as an alternate. But the astronauts whose lives are dependent upon it say that is not as safe a procedure as to overcome the possibility of fire on the launch pad with 16.7 pounds of oxygen in the capsule.

There is no simple, easy answer. This decision to use gas is not a stupid decision, and whether or not the country can accept that when I give it to them next Tuesday morning at 10 o'clock in the Senate, I do not know, but that is the kind of thing that is going on here.

Is that enough on that question?

STUDENT: Yes, sir. (Applause)

QUESTION: Sir, one informal criticism, perhaps never openly stated, of the space program is that NASA does not use integrated contractors on their major systems such as were used in the Minute Man system, and that it does prefer to manage and do the integration itself.

Will you discuss the pros and cons of major systems like Atlas asking for not having integrated contractors?

MR. WEBB: The first thing you have to say is that Atlas is not a major system in terms of those we are developing.

STUDENT: Sir, I meant Apollo, not Atlas.

MR. WEBB: The problem you have is that you are going to the Boeing company after competitive negotiation with the first stage in which the investment is something like $1.5 billion. You are going through segments that are very, very large. Out at

Huntsville we handle $1.8 billion worth of volume every year. Of that, $1.5 billion goes outside. We have introduced into that capability not only the extrapolation of the fuels we have learned how to use in Atlas and the RP-10 type of fueled boosters, but now liquid hydrogen as a fuel of the second and third stages. Huntsville manages the development of the stages of the Saturn 5 and the Saturn 1-B.

There is a common use. The second stage of the Saturn 1-B becomes the third stage on the Saturn 5. The instrument unit on the Saturn 1-B becomes the instrument unit on the Saturn 5. These are very large and expensive developments, running between $500 million and half a billion.

You have the problem of having test stands that you can build only once. The Mississippi Test Facility cost us $250 million. We have developed a system by which industry could compete in the future and the Government would not be locked in. The stuff flows under management of our centers toward assembly at the mouth of the Mississippi River. It comes around through the canal by water, on in by the pregnant guppi, floated on down the river on barges, but basically the end result of about $16 billion worth of work in factories flows toward this point and toward the cape.

It goes over the 35 miles to the Missippi to be tested. If you blow up a stand in Mississippi, you can go up the river to Huntsville, where you can find the research stand that was built for the first item. All of this is an integrated system for the development, production, assembly, test, and launch of very large systems.

General Electric Company wrote me a letter when we started on this and said: "If you will give us the contract, we will put that man on the moon, and you will not have to do more than give us the contract and get us the money." We did not think any company could do it, and I would like to point out they were not successful in getting the B-58 built with one integrated contract, and they had to go to someone else when they came to the missile systems.

We chose to introduce a technical interface with the contractor at our center level in addition to the accounting and legal administration of contracts, and right there, under General O'Connor, who is such an outstanding man that I would have to put him up close with Sam Phillips, although he has a slightly lower job in the echelon; he manages for NASA and keeps within his own head for use by the Air Force and Armed Military

Services the knowledge of how to produce these big boosters. He uses men out of the Goddard Laboratory, a man to be the manager of the Goddard system of Saturn. Then that man draws on the resources of this laboratory. You have a close-knit technical interface with contractors with management room in which we monitor every day 40,000 different parts made in 12,000 factories. We have never found a way to give that kind of responsibility to one contractor. We have not learned how to do it. These are such large units, and the trade-offs between, say, spending money to increase the engines 5 percent so you can then put more weight into the spacecraft, we never found a way to avoid the responsibility for making those decisions ourselves.

We have created a system that will work, if given an opportunity to work, and my major argument to the Senate next week is going to be that the country should let this system work because it has proved in what it has done up to now, from Surveyor and Lunar Orbiter on to Mariner, which brought us back 21 pictures of Mars, and which has now gone on around the sun. We have been communicating with this little old machine now 2-1/2 years, and we have been able to build a 210-foot dish in order to reach it through the atmosphere of the sun as well as

through the atmosphere of Mars, giving contracts to American industry. My argument is going to be: "This system is working; give it a chance!"

One other item: The people who work in this great, broad, and good country always can tell you how to do something better if they do not have the responsibility or if they are competing contractors. Also, when you have a major perturbation like this fire, you will find you were caught with your pants down. All of us have done that. NASA did not do a good enough job in moving fast with its own organization to handle this massive on-going program. Interestingly enough, we had a meeting 1 day before the fire to lay out the major organizational and integrated changes between Houston and the cape. In 1 more month we would have had that done, but we did not get it done. Therefore, we looked pretty bad and were entitled to look bad in the report of the board. Further, let me point out that the minute this fire occurred, everybody began to get out the seven-power glass and the microscopes and look at everything. If a piece of wire required a 180-degree overlap for a soldered joint and it had 175 degrees, but not that extra 5, it was rejected by an inspector on the sheer mechanical thing, even though it was a good soldered

joint, and out of the 2,000 white tickets on that 017 spacecraft down there right now, there are about 400 items that should be changed, and that is normal. But let me point out that in addition to having a spacecraft intended to be flown by three men, three human intelligences that had been trained for a good many years, you now have an overlay of all the automatic equipment and wiring to fly it unmanned and boost it to lunar return speeds and drive it into the earth's atmosphere. So, you not only have a normal capsule, but you have all this overlay of temporary wiring and equipment inside this thing. It looks terrible to anybody who just goes and looks at it. Every workman who goes in there to do something runs the danger of doing something wrong or dropping a tool or doing something that interferes with this maze of stuff in the spacecraft.

It is almost like trying to put a nuclear submarine on an aircraft carrier in the elevators you ride in here in this building. So, this is no simple thing. It is not really out of the normal course of this kind of work to have 2,000 items of the kind we have on 017, and we are going to fly 017; I believe it will be successful.

It is a pretty difficult thing to put a massive amount of equipment like this together, to build $2.5 billion of capital equipment

on the ground specifically and directly aimed at being able to assemble, test and launch these kinds of equipments. The integration of it is a skill we must have in this country. If one contractor got this job, I do not know whether anybody would ever get into the business again.

Boeing does integrate the whole stack of Saturn 5 as well as build the first stage. We have gone to that kind of outside of Government integration.

Is that enough on that subject? (Applause)

QUESTION: Mr. Webb, will you give us any results of the recent Russian tests as compared with the United States?

MR. WEBB: All of this is somewhat limited if you are going to publish your transcript of what I have to say. I think I could say this, that there is strong evidence that they are having serious difficulty on this flight prior to the re-entry, strong evidence that they endeavored to re-enter twice before they succeeded on the third attempt. There is considerable evidence that there were other problems related to stabilization and control and that the announced difficulty of the parachute in re-entry system may not be the only thing they have to correct before they can fly successfully with this next generation of spacecraft.

The second thing I would like to say is that they are building larger boosters than anything we are building in this country. They are building boosters bigger than the Saturn 5, getting ready to launch very large payloads. They are in this business to stay. They have about the same amount of effort that we have--man-hours and resources going into it--and are developing all the options they need to select those that they believe are best for them. When and where they will fly these larger equipments or what options they will select are not known to us. We cannot read their minds. We can only judge from what we know is being done.

There is considerable evidence that they still would like to do two things this year, which is their 50th year. They would have before this accident--put it that way. They would have liked to have made a planetary landing sometime about the time of the November anniversary and they would like to have had a linkup of very large spacecraft with transfer of crews and a lunar fly-by. If this flight had proved successful and the next one had proved successful, they might well have done the latter. Whether they actually could have made the planetary landing is a question, a serious question, because they have not made the kind of advances

in stabilization and control that we took the time for, I believe. Is that enough on that subject?

Do not underrate what they are doing. I do not know whether they mean it as a major military operation; it certainly can be a very powerful psychological threat. The missiles in Cuba were not a real military threat in the sense that you fellows would not know how to overcome, but it was a major psychological gambit. In space you are going to see more of that. And you are not going to see just one of them, in my opinion.

QUESTION: Audie Roland made a statement this morning on the radio that the first trip to the moon might be a plot-around instead of a lunar landing. Will you comment on this?

MR. WEBB: There is absolutely no foundation for any kind of speculation along this line. We are going to launch the Apollo system. We are going to try it out in earth's orbit. We are going to separate the Lambda (?) and the Apollo and going to work with them, be sure the equipment is right. Then we are going to turn equipment loose toward the moon. Whether we are going to orbit around the moon and decide to come back home without landing is going to depend on the equipment. The equipment is built under what Sam Phillips and George Miller put together as an all-up systems testing concept, where we did not

have the money. We were cut $600 million in 1 year in the Congress. We had to get rid of the stage-by-stage testing and go to the all-up systems concept. This means that on every launch we are testing out practically the whole equipment, after the first two or three, all the equipment and all the launch procedures and everything to do with it.

That means there is no reason why some of the early flights could not be turned loose to the moon, but I do not believe we are going to do it. I do not believe the equipment in this massive application of technology is going to work that good. I would say that if it does get as far as the moon successfully, very likely it is working so well that you will proceed with the landing, but if you are going out there and you are going into orbit around the moon, you can surely fly around it and come home if that is what you want to do. But the equipment is going to be there to land if the boys decide they want to land and are prepared to land.

QUESTION: Has your agency observed any correlation between the earth's gravitational anomalies and errors in inertial guidance systems?

MR. WEBB: Gee, I do not believe I am technical enough to answer that. I believe that the effect on satellites in orbit and the system we have worked out with the military Services and scientists like the Harvard Astro-Physical Group and the stations we have cooperatively established abroad are giving us very accurate knowledge of what happens to spacecraft within the field of gravity of the earth and very accurate knowledge of positions on the earth. Now we know Bermuda is not where we thought it was in the war years.

My own belief is that through this combination of effort in which the military Services have been extremely active all the missile systems we have, have a value of maybe 20 percent greater than they would have had because of the knowledge of where things are.

With respect to whether anomalies in the system, in the earth's gravitational field, well, I just do not believe I am qualified to answer that question. I do know we are learning a great deal about gravity and about gravity at the moon and at the planets or else we would not have put the Lunar Orbiter into orbit out there and then dropped it down twice and finally got it into an orbit 27 miles above the moon. There is yet to know something about

gravity, though, if that is what you mean.

QUESTION: Sir, a recent article in Technology Week was critical of NASA as not pursuing research in the aerodynamics field to the extent that NACA used to, particularly in such veins as high-mach regimes, airfoil configurations, engine-to-air-frame matching, and things like that. Will you comment on what is being done in NASA?

MR. WEBB: First of all, I would like to comment on the publication. It is very easy to criticize a large program. We are spending this year over $100 million and have before Congress something like $130 million to $140 million in the aeronautical field. We are wrestling along with the military Services and FAA and the Department of Transportation, with a new situation. You can oversimplify it by saying that an airplane today in the military Services is not an airplane; it is part of a weapon system; it is a specialized unit developed for that purpose, does not give you the proof of concept for commercial operations that we previously got from systems like the B-52, let us say.

Where does the country get this kind of proof of concept for vertical and short-takeoff-landing airplanes, for the supersonic

transport; we must have invention of a new way to move into very advanced areas of technology. In our program we have far more than that article would imply.

Several years ago this same kind of charge was made. I got Dr. Arthur Raymond, who is the most knowledgeable man I know in the field, to look at all our work and go to every major company and ask what they thought should be done that we were not doing. It turned out that we were doing practically everything that any company said we should be doing, but they did not know it. They had not bothered to find out. So now we have introduced the old NACA system of center visits. We recently did this at Lewis Lab on propulsion.

I would say, first of all, there is a strong desire on the part of a lot of people to increase the amount of aeronautical research. We have our own role. We have deliberately made a policy decision not to reach for building the next flying test bed following the X-15 ourselves; we think the Air Force should do that. We think you will not have a good Air Force unless they build these advanced flying test beds and we cooperate with them. Yet, the tendency is somewhat the other way. The X-15 has been pretty well turned over to us now, with minimum Air Force

participation. The B-70 has been turned over to us to do the instrumentation, the ringout, test the sonic boom, with minimum participation by the Air Force and with NASA money going into it.

I would say that when we put a mach-8 engine into our 1968 budget and have let the contracts to start the redevelopment work on it and going to fly it under the X-15 to test it, this is a pretty good indication we are reaching out into pretty high mach numbers. Right now we have a contract to develop a mach-8 engine and a program to fly it under the X-15. There is no wind tunnel within which you can do that kind of testing.

We have a large amount of work done in aerodynamics and have developed through simulation techniques a means to take various engineering designs and the formulas that come from them and put them through computers and get very much the same kind of information we used to get through wind tunnel models. We do not trust that completely, so we go on the most desirable configurations to wind tunnel models and then on to the manufacturer for the proof of concept.

We have even reached back to retrofit. We have $11 million going into contracts with Boeing and Douglas to look at

the noise problem on these stretched versions, like the DC-8, for instance.

I would say there is a vast amount of work going on here, a return of a lot of able minds who went into the missile business into the use of aviation, and a very large amount of work that is not talked about in testing the commercial kites, small airplanes. We already know a great deal about the dangers that private pilots encounter which can be overcome with control augmentation, for instance. We know the mortality rate under abnormal weather and navigation conditions can be cut substantially, but this is not something you throw into the public arena, again, too vividly because some manufacturers are beginning to incorporate this kind of thing.

The simple fact is that the control augmentation systems are more reliable than the airplane there, whereas just a short time ago that was not true, you see. I simply say that this is in the arena of public discussion of an agency, a good thing to foster debate, but I doubt this country is willing to put any more money into these things than we have asked for. In fact, I hope we do get what we ask for.

(B R E A K)

DR. HOUSTON: This is to remind you that Mr. Webb's remarks carry no security classification, but we do remind each of you of the nonattribution policy, so regardless of classification, our speakers are not quoted outside the room without their permission.

QUESTION: How important to the goals of your program are overseas installations, such as those in Spain, Southampton, Madagascar, and so on?

MR. WEBB: Those installations are extremely important. We concluded that the only way we could operate in space was to have as nearly continuous telemetry and communications with the spacecraft, both manned and unmanned, as possible. We have invested a great deal in these stations. We are now in the process of updating the 85-dish network for the deep-space net to 210-foot dishes. As long as we can locate these at equal distances one-third of the way around the earth, we can communicate out with Mars, Venus, the moon, as the earth turns. It is rather remarkable that instructions are given to Surveyor through a station in Australia because you cannot see the moon from the earth at that time. We are not in a line-of-sight position with the moon. Therefore, we

go through this network.

There is a redundancy of the communications system so that if one system fails, we can go to the other system.

The Russians lost their flier, and they were not able to communicate with him except for limited times with indivisibility of their stations. We were not able to locate the trouble on Gemini 8 and save those two astronauts except by having enough capability. You will remember the trouble started when they were out of visible range for a very small number of minutes. When they came in range, we were able to diagnose the trouble and to get it worked out although the astronauts themselves played a very major role. Their long period of training, their long and detailed association with the equipment, and knowledge of the engineering features of the equipment permitted them to make major contributions to saving themselves, but in the end it was the total system. It was the wonderful cooperation we have had from the Navy in extremely intelligent planning of the recovery forces and of the Air Force that permitted those boys to land 500 miles off Okinawa with an airplane right there to see the parachute open from an emergency landing. Do you follow me?

These stations are absolutely essential for the kind of operations we are conducting, and I think it will be some time before we will be prepared to turn loose these very large systems.

Remember, one Saturn 5 launch fully equipped for the lunar mission costs $300 million, one launch. You do not want to just turn these things loose and see them for a few minutes, then lose them awhile, then see them again. You must check the system out in orbit before you launch from orbit to go to the moon or Mars. So, these worldwide stations are extremely important.

Let me say they are important also in our areas of national projection beyond the space program. In many of these areas the scientists of the nation where the station is located participate in the operation of the station--the engineers and technical people. This is the most modern equipment they see. This inspires them to learn more about the modern areas of technology. It livens up their own way of thinking about their own future. In the case of the weather satellites, we tell them a simple thing; we say, "We do not want to get power over you through this new technology. We would like you to develop power with us; therefore, just tune in on that weather satellite and get the weather over your country and integrate it with the knowledge you are getting on the ground, and send us the summary of it.

But our satellite is open to you. This is our message: We want to develop power together to use these things." This is a very powerful message, and these stations have very important functions in many ways, in my opinion.

QUESTION: Sir, in some of the old press bits it is indicated sometimes military experiments are included. Some people argue this is in violation of the agreements with some of these countries providing for the peaceful exploration of space. Will you please comment?

MR. WEBB: What we have done is to operate under a law that says the exploration of space and the increased competence to be developed in the United States will be devoted to peaceful purposes for the benefit of all mankind. We have operated in the open in order to meet the requirements of this law. But the law also has another section. It says that it will be the responsibility of our military Services to utilize technology developed out of NASA and developed in their own way through their own research programs to meet their needs, and that the full information we develop will be available to the military Services, who will have the responsibility for weapons systems development or other military developments. The law also requires coordination.

It recently set up a thing called something indicating a liaison and control mechanism--I forget the name of it. President Eisenhower did not like this. He did not want the Space Council to operate except when he was Chairman, so in a sense we developed administratively a series of aeronautics and astronautics coordinating boards, of which there are quite a large number with the military Services. Incidentally, we have developed this with FAA and other areas--written agreements.

Under the agreements that we have, and this is well known to those stations, those countries like Mexico that never permitted a military installation in their country since the revolution in Mexico, we honor those agreements because where we do fly military experiments, we do not involve their station in the work involved. We generally have been able to get agreement. Where we could not get agreement, we took this as a limiting feature. Up to now this has worked very well.

Just as an illustration, we are going to fly in the ~~split~~ aft stage of the S-4B some experiments the Air Force needs a year before they can incorporate them in the MOL and therefore gain the benefit of these. They are not things apt to do with weapon systems: How does a man sleep in space? How does he

move around when there is no gravity in a great big inclosed tank? How does he stow his gear? There are a lot of questions like this, things not directly military, but our application in the first instance is military.

QUESTION: Mr. Webb, will you identify the astronauts of the immediate future as to whether there will be a change of age, physiological, psychological, and educational requirements?

MR. WEBB: I would like to say first off that the astronauts who came to us from the military Services included some of the most outstanding men this Nation has produced. They have gone through a period of disciplined nautical experience to become test pilots; they then became astronauts and in addition were engineers. They have developed major new methods of simulating new conditions so that almost every new man who went up said, "I have seen this before," when he encountered something in space, meaning in his training and simulation work.

As we moved to have competence in the second- and third-generation spacecraft and saw the tremendous possibilities of working in this new environment, out beyond the air, this unlimited environment which was not narrowed by the boundaries of a nation, not narrowed by water or the air. We concluded that

we could take some astronauts who were capable, who were already qualified in science. Buzz Aldren's father was the chief pilot of Standard Oil. I used to fly with him back in the 1930's. He went to MIT. As a military officer he wrote his thesis on the problems of rendezvous. Later, in action, he saw the United States Government adopt his theoretical approach to rendezvous, and he applied it in person. That is the kind of men who came into the second group of astronauts.

We now have moved to the third group, in which we are inviting scientists who want to do geology on the moon--geologists --to come in as geologists, and we will teach them to fly. So, you have moved all the way from having only the experienced jet test pilot to where you will take people who do not know how to fly and train them because they are outstanding scientists.

As to age, I would say that we are not going to go up into the higher age brackets because our purpose is to send the man who can do the job and to have him available for a period of time after he has done the job. I think one of our major policies has been to have these men available to the military Services when they need and want them.

We have worked out further arrangements that involve the astronauts and other military personnel. We have 126, I think, Air Force personnel in our operation at Houston. They are doing work for us and training for the MOL program; we pay half their salary. These kinds of arrangements are going on all the time.

I do not know how to state the profile of the man who may sometime go to Mars; I really do not, or woman, if you want to put it that way.

QUESTION: Mr. Webb, earlier this year in a lecture at The National War College given by a so-called scientist from the Department of Defense, in addressing the prospects of future R. and D. developments he gave a very pessimistic view. In his judgment, there would be no prospect for any major breakthroughs in the next 15 or 20 years. I happen to believe there is a good prospect in the area of energy sources, the magnetic spectrum, and a numerous others, that there will be breakthroughs.

You have had the opportunity to work with some of the most brilliant people from many disciplines for the last few years. Will you give us your estimate of the prospect of the realization of some real scientific breakthroughs in the next few years?

MR. WEBB: Let me say right off that I am not a scientist. I am a lawyer and administrator; I am not even a so-called scientist. I might be a so-called administrator. (Laughter)

I think it is important to answer your question and to answer it in a slightly different way, maybe, than you expected. When this agency was formed, the international geophysical year of work had come to a conclusion. I was approached by some scientists, excellent ones, and some not so excellent. They said, "We want to establish committees and groups to, quote: 'Help you run NASA,' unquote."

I declined the invitation and decided all our work should be to strengthen institutions in our society. The work we did with the Air Force in its installations should help the Air Force do what it wanted to do rather than bring strength to us from them. The same was true for universities, the same for the National Academy of Sciences, the same for an industry. So, we have a Space Science Board, appointed by the National Academy of Sciences. We furnish $320,000 a year with a full-time staff of six to service them. They monitor our programs, not on an ad hoc basis, but on a continuing, responsible basis. They send

their recommendations as to future science to be done and evaluation of what we are doing to the National Academy, which immediately sends it to us and publishes it. So, the newspaperman, the Academy, the Congress, every member of the Academy, have to take some responsibility.

If I appeared a little while ago to quarrel a little with the system of doing everything in the open, I think this is a great country. As I said the last time I was here, I think it is a little like a raft; you do not sink, but your feet are always wet; it is not a comfortable craft on which to travel. (Laughter)

Basically, the scientists who have chosen their peers in the National Academy of Sciences are intimately involved in the future. They say that one of the most important things to consider is the existence of life elsewhere than on this earth so you can compare life here with life elsewhere and learn a lot more about life. They say it is very important to marry the disciplines of astronomy and geophysics in work at the planets where the astronomers have to come back from the stars and the geologists have to move out from the earth and marry these disciplines at the planets in order to get a general theory of various phenomena with respect to the planets to understand the earth better. They say

this is extremely important, and there are important knowledges which can probably be applied through our total systems engineering but probably would not qualify as a major breakthrough of the kind you described.

In the life field, they think there will be a major breakthrough.

One other point: I do not want to belabor this too long, but it has been extremely interesting to me as a layman to see that when Lindberg flew, in 1927, astronomers like Harlow Shapley were reaching out with telescopes where they thought something that looked like a star was a tremendous number of bodies in space because they had a better telescope. You had the intellect working and the man of action in Lindberg. We now have astronauts as men of action and astronomers within the last 5 years have identified that these major areas of energy are called quasars--quasi-stellar objects that you cannot see, or if you can see them are very dim; they think there is something beyond nuclear energy generating these kinds of phenomena which we do not well understand. But you again have this major effort, the man of action, with his willingness to take the risk of going out personally for observation to increase what you can get with instruments, plus

the fact that you are no longer within the envelope of the air.

Right now we are establishing a Lunar and Planetary Mission Board and an astronomy group that will operate, not in a telescope on top of a mountain, but in a center on the ground connected with telemetry to telescopes in orbit. We have a plan where the astronauts will go up and refuel these telescopes, reposition them, add new equipment if necessary, about every 3 or 4 months. You now have a new phenomena where the most brilliant minds on earth will be connected with modern technology with instruments above the earth's atmosphere and with instruments operating not just on the moon, but on Mars. All this will take place in the next 10 years.

My view is that even with what we already know, you are going into a decade of development as soon as some of these problems get out of the way, as soon as we convince the Communists in Vietnam and elsewhere that they are going to have a loss instead of a profit when they start to upset the world, and that not having been permitted to put missiles in Cuba, they are not going to be permitted to keep the world upset, that we have power based on technology; we are going to use it to stabilize the world and then enter a major decade of development, and I think this will include

military developments as well as many, many related to the 3 billion to 4 billion people on the earth's surface.

Is that a good enough answer for you?

Let me add something there, please. We have gone, now, beyond this space science board. We are now working with a new Academy of Engineering, which doubled its membership last week. They had 99; they added 99. We are establishing an Aeronautics and Space Engineering Board on a national basis and are going to pay for a staff. We hope the Air Force, HUD, and Transportation will use them, too. We are now negotiating for a Public Administration Advisory Board. So, you will have three legs to the stool--science, engineering and technology, management--with national professional groups established on a peer basis and taking some responsibility.

QUESTION: Sir, do you plan to switch from a water to a land recovery in the future?

MR. WEBB: Well, yes. We are going to develop the capability through the Apollo applications program if the $452 million we requested from the Congress for that program is approved in this next year. Bear in mind that these early flights are safer going in the water. You have to be able to land in the

water because we fire over water; otherwise, you lose your men and equipment. Nevertheless, we do want to experiment with the land landing and have it available for anybody who will use this equipment. Remember, NASA is not going to be the ultimate user of these big systems anymore than we are the user of the communications satellite or the weather satellite. This all gets transferred to somebody who wants to use it.

We do have a plan to develop a land landing capability in the Apollo and also to double its capacity to six men at some time as we move along, and then to be prepared for the next major system if somebody wants to buy and pay for it.

QUESTION: In previous years when people were considering different concepts of interplanetary exploration, one concept stressed was building spacecraft in orbit from inflatable structures. Does NASA consider this concept valid? Are we doing anything about involving the basic technology?

MR. WEBB: Yes, sir, just like we are working with the mach-8 engine, although most people think we are neglecting aeronautics. We have a wind tunnel now to simulate vertical takeoff landing craft. We have a moving surface within this wind tunnel. We are doing the same with respect to these space

structures. We are continuously working under contract with industry to work with these inflatables, and with enough in-house capability.

We also are looking at a 10-mile long radio astronomy structure which we believe we can deploy in space with our present knowledge. We are developing, I believe, a large amount of technology that can produce this kind of thing.

I think in the Apollo system we will move rapidly to determine how much gravity you need to live and work in space, how much conditioning through squirts of gravity, if you want to call it that, are needed to condition you to return after being in space for long periods of time. We also have to work with two gas atmospheres when we get to periods beyond the month. So we have those three major areas. But there is no doubt in our mind that our extra-vehicular knowledge and our ability to put in the nose of a rocket and then unfold in space tremendously new and different and capable equipment will result in the kind of thing you are talking about.

I am not sure they will all be inflatable, but some part of them very likely will be.

QUESTION: Mr. Webb, some people in the United States who are convinced we should explore space are not persuaded that we should be doing it at the rate we now are doing it. They point to Vietnam and say we are in poverty. I wonder if you can give us information on the public and congressional support for your program?

MR. WEBB: Remember, we gave 4,000 pages of testimony last year to the 124 members of Congress on the four committees that consider our program. We will be here tomorrow at this time if you want me to give all that.

I would like to comment that we have eight regional experimental dissemination centers for the information coming out of this program that may be used in nonspace industry as well as a very large storage and retrieval system for our contractors, of which there are 20,000 at the prime and first- and second-tier levels.

The 1,000th technical brief described a new hexagonal crystal material that we can put into bearings and not get catastrophic failures when the lubrication fails. It happens also to be very good for hip joints. This was number 1,000; these are all published and for sale. I think you can buy them for 20 cents apiece at the

Department of Commerce. There is a vast array of this kind of thing which Congress looks at.

As to the psychology of the thing, I find that responsible businessmen and visionary-minded young people are tremendously intrigued by what is going on here. I spoke last week in New Orleans to 2,000 members of the Edison Electric Institute. The utility industry does 18 percent of our GNP; they invest $4.5 billion of capital a year. At the end of this presentation the president of that organization went with me into a press conference where all the radio and TV were. He said, "I want to tell all of you that every dollar of that $4.5 billion we are going to invest this year in the utility industry is worth more to the country and more to our industry because of the technology and the way NASA develops its technology and makes it available to us."

That was a pretty strong statement and illustrates generally what I found. I went out to South Dakota last week with Senator Mundt. He asked me if I would go out there to help them install a new university president at the University of South Dakota. I was a little surprised that Senator Mundt would ask me, the Administrator of NASA, to go to South Dakota, but I decided I would go if he would go with me, which he agreed to do. It was in

the period of controversy about the fire. He got up and made quite a speech about what the program had done, that he was serving on the Harris Committee, that he was very interested in the dispersal of research and development so South Dakota could begin to play its proper part, and then said the program operates in the open, utilizing the resources of the country, and that is important. He said, "We of South Dakota should look at it, and I am here to say it is a good program."

He got applause from the newspapermen there in South Dakota. They had come from hundreds of miles around. One happened to be from Minnesota. You know Senator Mondale had asked me these questions in the conference about the Phillips Report. It turned out after I left there he found his Minnesota papers had been pressing me pretty hard as to why we chose North American for the Apollo contractor after the Gemini experience. I pointed out the Apollo contract was let before Gemini was ever conceived and before we let the Gemini contract. It is easy to forget that Gemini was an interim program.

It turned out Mondale was going to be there the day after I was there. But the point is that both Mundt and I got a tremendous response in terms of really putting this program forward as to what it meant.

The high school seniors and college freshmen are tremendously interested in what the human race can get in the way of new concepts of reality of the universe in which they are going to live. They do not think of something as being out of this world; they think of it as being out of this universe now. They conceive of the universe as something of which they are a part. They understand motion. When they see an astronaut going around the earth or Surveyor fired from a surface moving 1,000 miles an hour as the earth rotates, go 240,000 miles and land on another body that is moving 2,000 miles an hour and dig a trench, they say, "By golly, we understand motion here," even the motion of the arm digging the trench they see on television. These people are tremendously interested in what the human intelligence can learn and apply and how they can answer those basic questions of life: Who am I? Where am I? Why am I here? Where am I going?

You know all the things people ask in their more serious moments. These young people believe something is opening up when man can leave the earth and travel around in space personally or vicariously and measure things that you cannot see or understand on the surface of the earth. The businessmen see this as an

application of technology that is tremendous, and I believe they see this decade of development coming up. The young people understand motion, and they see realities they never saw before. Congress somehow responds to this. I cannot tell you why. They have voted these large appropriations, and, in many cases, unanimously.

There have been efforts to cut the program--10 percent on the floor of the Senate every year. Some of them succeeded in earlier years. In the last year or two they failed. I believe there is more support for this program than the little coterie of mass media reporters who would like to run it indicate in their columns and in their commentary on the networks.

QUESTION: I guess maybe if they cannot find why they are here, maybe they see a chance to leave. (Laughter)

MR. WEBB: Maybe there are some we could send. (Laughter and applause)

QUESTION: Mr. Webb, will you tell us some of the arguments you might give in answer to Senator Proxmire's statements on the SST program?

MR. WEBB: Yes, I could. It has cost about $100 million and 4 years' work to develop the modern subsonic jet airplane engine.

Remember, the first fully systems engineered thin-wall structure that married the engine to the structure was the DC-1, 2, and 3 series of airplanes. That was in the early 1930's, completed about 1933, 1934, 1935, along in there, with a successful airplane. We have applied that technology right on up to the modern subsonic jet, using these engines that cost $100 million to develop. We have them so reliable through the process of testing and testing and flying and flying, that those engines now run more than 1 year between major overhauls, fly all over the world, in all kinds of weather, delivering the safest, most reliable, cheapest transportation the human race has ever had, a little over 1-cent-a-seat-mile in a modern subsonic jet of the larger kind.

The hot parts have to be taken in about half that time, but the basic overhaul is over 1 year. The big lines like TWA fly about 9,000 hours a year. These engines now run sometimes 12,000 hours between overhauls.

We are developing for the supersonic transport a very much larger engine to operate at higher temperatures and higher pressures, but we have the technology to do it, and it will again, having spent about $600 million and 6 years' work give us at

supersonic speeds the fastest, safest, cheapest, most reliable transportation the human race has ever had. Are we going to stand aside in the development of that kind of technology? Are we going to have the world see that while we could do it, we are not going to do it--somebody else is going to do it?

I could also give you the balance of payments problem. I could give you the fears of people in the fiscal field that this airplane is going to have such a powerful effect in stimulating international travel that the dollars Americans spend abroad will increase and hurt our balance of payments problem. I could give you both those fields of arguments. But basically, I believe that the future balance of power among nations is more dependent on the balance of technological capability and the momentum of development than on any other factor. The power position today is based on something else, the technology of the past, but if you look into the future, the balance of power is going to rest on both the state of technology and the momentum of the system that develops it, and the supersonic transport occupies a very important place. Furthermore, there is no doubt in my mind that we will find a way to design out of those airplanes a good deal of the sonic boom problem and that in the end it will have--although I

know this is a debatable question among you military men and your superiors, I believe that any airplane that will go anywhere in the world in, say, 3 or 4 hours and carry a payload is going to have some military value. It just does not seem to me that it would be logical that that would not be so. Anytime you have a vehicle that can travel fast and have a good, reliable engine in it that could operate anywhere in the world, it seems to me this certainly has an image capability aside from these other matters.

You could ask: "Is that going to be more important than poverty or more important than metropolitan area development or developing better statistics for the SMSG type of concept?" I would say we have to do them both, and I would say that with the kind of gross national product we have, which has increased, gentlemen, over $200 billion [a year?] in the last 5 years--our gross national product is now $200 billion a year more than it was before we entered these major systems of development; if we enter a self-denying ordinance with respect to these very-out-in-front things on the basis that you are now going back to solve poverty, I do not think that poverty will be solved except through the things that make the supersonic transport possible. (Applause)

QUESTION: Will you please be kind enough to discuss with us the fine focus of NASA's effort after Apollo?

MR. WEBB: Well, now, NASA's effort is not what is going to determine the future. It is what the country is willing to do. We are developing options the country will have to consider. The 1968 budget for the first time asked the Congress to approve a production rate of eight Saturn vehicles a year, four of the small ones, four of the large ones. The large one will take two vehicles to Mars in 1973, will maybe give you two a year to the moon, one per year for synchronous orbital operations or other large systems, development of space stations, but basically, we are asking for a stabilized rate of production at eight per year and for two new major things. One is the money to take the present Apollo system and learn to use it by parking stuff in orbit. We do not have the money to launch and use equipment and then let it burn up on re-entry, so we have developed the concept that we are going to put into orbit a second stage of the Saturn 1B, which holds hydrogen for fuel. After we burn up the hydrogen, we will open an air lock. The astronauts will go out and work and prove out that equipment. They will come back to this empty tank, enter through the air lock, and begin to build a

station there that will permit them to learn how to sleep, how to eat, how to work, and all the different things you must learn in a primitive, inclosed structure.

We will add to that a mapping and resource unit and four solar telescopes so that now you have a system that puts you up into space; you needed it to get there; you have left it there; you keep adding units; you go back every 3 or 4 months with a flight; you refuel it, use the engines on the service module to push it up a little so it will not come down and re-enter, and just work with this for the next several years, parking stuff in orbit and reusing it time after time. This is the basic concept of the immediate period.

The second major program is to use the Saturn vehicle to put two automated biological laboratories on the surface of Mars in 1973 and another package on Mars in 1975. Therefore, we will be using these boosters to reach out into the planets and to develop experimentally the capabilities of man in operation around the earth. I think this could then result in the Nation's deciding that it wants a composite large system that would do earth resource development, mapping, monitoring, that would do communications, that could do many, many different things;

even send scientists up there and give them a hotel room in which to stay and a laboratory to work in if they have something worthwhile to do. I think you are going to find here a return on invested effort or invested capital that will make the country want to invest the money, just like they are going to get, in some estimates, as much, maybe, as 20 percent per year on invested capital in the supersonic transport.

I think our effort now is an experimental one to prove that is the truth so that people will be willing to make the investment.

DR. HOUSTON: Mr. Webb, our time is just about up. Would you like to address yourself to some particular point which has not been raised, or elaborate a final word?

MR. WEBB: Only this: It seems to me that we and the Russians are looking at the same thing, in a way. We want something to inspire our youth to work harder, study mathematics, learn administration, how to manage large things. We want to be sure we have a momentum in technology that permits us to be there when the big decisions of the world are made and have military power that permits us to be there. We want a system that permits us to form good judgment as to how to use that power. They are very anxious to work from a centrally controlled system

to inspire their youth, also, and to upgrade their economy. Many careful students believe that the driving wedge of all the technologies necessary to work here, in energy, modern electronics, new use of/materials, total systems engineering, and the human beings in the system, is the only way Russia can really modernize its system fast, that the resistance within the system which Khrushchev found and which probably caused his downfall is so great that only through something like this can they move forward and develop the full impetus they wish to employ to rule the world. So, in a sense, we are looking here at who is going to be there when the big decisions of the future are made.

Thank you very, very much. (Applause)